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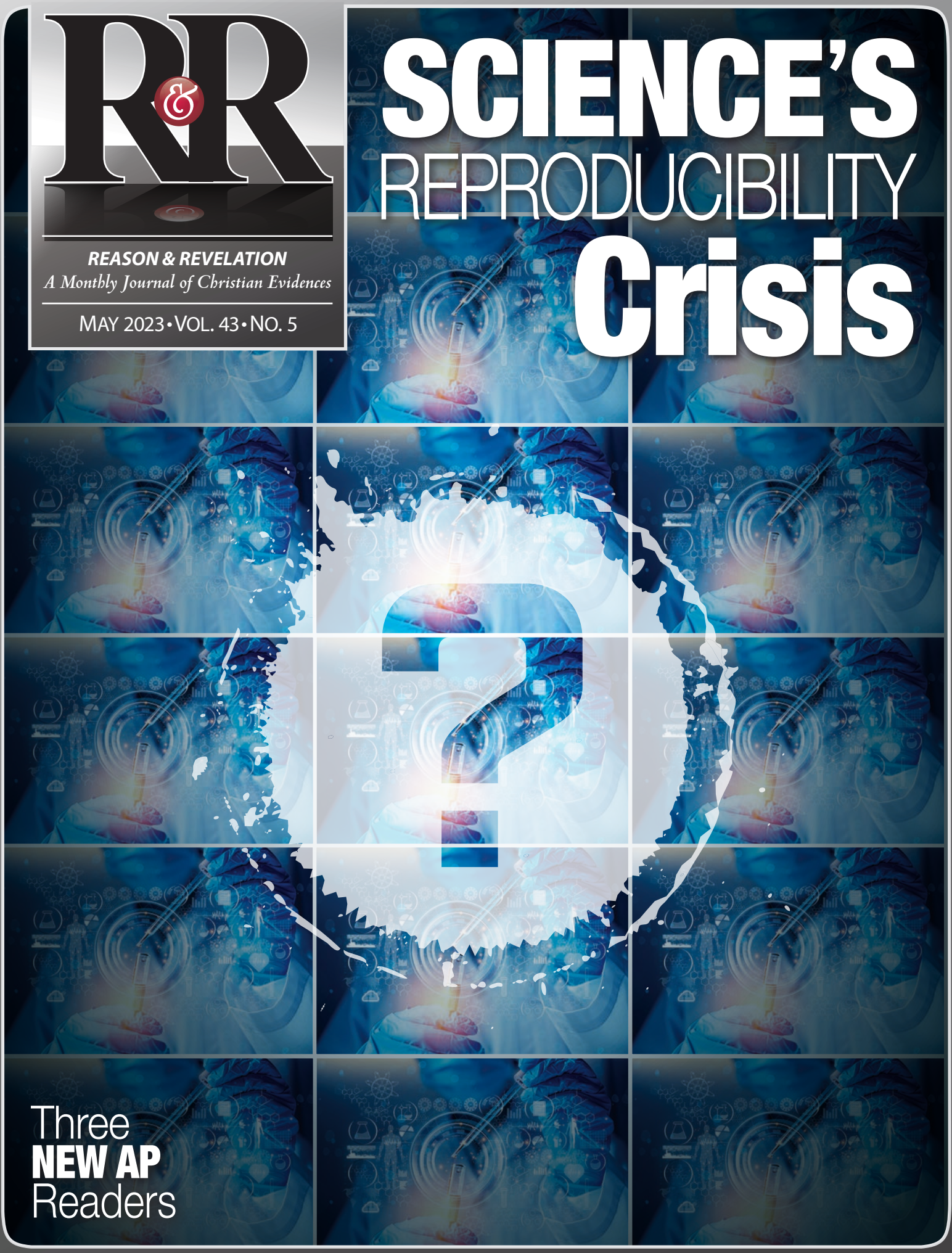
SCIENCE'S REPRODUCIBILITY Crisis



Three **NEW AP** Readers

IN "SCIENCE" SHOULD WE TRUST?
The Ongoing Reproducibility Crisis

Jeff Miller, Ph.D.

Article In Brief...

By unspoken consent and, no doubt, many times unconsciously, modern American society blindly places its trust in the supposed findings of the naturalist-dominated scientific community. Given the ongoing reproducibility crisis in the scientific community, however, the logical person should seriously reevaluate where he places his faith.

HOW can the scientific community know a scientific study can be trusted? How can we know that a scientist did not fabricate, exaggerate, or bias his or her results in some way so that the study would achieve the desired conclusion? Reproducibility—the ability of a different group of researchers to replicate the same study and arrive at the same results—is a key tool available to the scientific community. If a researcher fabricates or exaggerates results, or conducts bad science in some other way, for instance, then another lab attempting to conduct the same study will fail to achieve the same results as the first study. The scientific community can then see the "smoke" that often communicates a flawed study. "**Replicability** is the basis of **all good science**.... 'When you publish a paper, it is your **ethical duty** to make sure other people can **reproduce** it,'" says Regius professor of chemistry at the University of Glasgow, Lee Cronin.[1] Writing in *Science*, Marcia McNutt explained, "Science advances on a foundation of trusted discoveries. **Reproducing** an experiment is one important approach that scientists use to gain **confidence** in their conclusions."[2] That truth makes the acknowledged but embarrassing predicament facing the scientific community over the past decade highly concerning. McNutt continued, "Recently, the scientific community was shaken by reports that a **troubling proportion** of peer-reviewed preclinical studies are **not reproducible**."[3] In fact, the problem is so widespread across the scientific community that it is being described as a "reproducibility/replication **crisis**."[4] In her article titled "The Unscientific Method," Sonia Cooke, writing in *New Scientist*, warned, "One obvious concern is that [flawed papers] could undermine public **faith in science** itself."[5] It should come as no surprise, therefore, that some scientists are expressing a frustration that, in America, there is a "crisis of faith in science."[6] Consider that many areas of science today are largely composed of naturalists, humanists, and atheists. Is that a bad thing?

> *"Replicability is the basis of all good science."*

THE REPRODUCIBILITY CRISIS

CONSIDER some selected quotes from the last few years concerning the reproducibility crisis:

- David Peterson, writing in *Nature*: "Alarm about a 'replication crisis' launched a wave of projects that aimed to quantitatively evaluate scientific reproducibility."[7]
- John Bohannon, writing in *Science*: "Concerns that false positive results might be **common** in psychology, where studies often involve small numbers of subjects and statistically weak effects, boiled over in 2011. The **scandal** spurred psychologists to clean up their field—both by replicating key studies and by creating new models of scholarly publication and peer review to restore confidence in published research.... In a report published in *Science* in August [2015], 270 psychologists orchestrated a repeat of 100 studies published in three top journals. On the downside, **only 39% passed the test**."[8] [Note that the 39% pass rate, as low as it was, was the rate **after** changes in the psychology community had been made.]
- Jocelyn Kaiser, writing in *Science*: "The Reproducibility Project: Cancer Biology...reported this

week that when it attempted to repeat experiments drawn from 23 high-impact papers published about 10 years ago, **fewer than half yielded similar results**. The findings pose '**challenges for the credibility of preclinical cancer biology**,' says psychologist Brian Nosek, executive director of the Center for Open Science."[9]

- Bruce Bower, writing in *Science News*: "Psychology got rocked last year [2015—JM] by a report that **many** of the field's **published results vanish** in repeat experiments," though the report "provides 'initial, not definitive evidence,' that psychology has a reproducibility problem." Attempting to provide an explanation, Stanford University epidemiologist John Ioannidis acknowledged that "[r]esearchers' **assumptions** and **expectations** can influence their take on any results, 'no matter how clear and strong they are,' he says."[10]

Understand that irreproducibility implies that the research being reported is possibly **flawed** in some way, which should lead to journals retracting the research articles if they catch the mistake. Daniele Fanelli, writing in *Nature*: "[U]p until ten years ago, retractions were extremely rare," but today, "retractions are nearing 600 per year."[11]

Donald Kornfeld and Sandra Titus, writing in *Nature*, acknowledge that the irreproducibility problem has, in actuality, long been a problem in science: "The history of science shows that irreproducibility is not a product of our times."[12] Does the layman individual who places his faith in science realize that fact? But how widespread is the problem in the science world today?

- McNutt explained, "It is unlikely that the issues with irreproducibility are confined to preclinical studies (social science has been equally noted, for example)."[13]
- "'Some will be tempted to conclude that psychology is a bad apple,' says Charles Carver, a psychologist at the University of Miami.... He insists this is not the case. 'This is a problem of science, medical science no less than behavioral science.' Replication efforts in other fields are **equally low**, says John Ioannidis, a biologist at Stanford University..., who suspects the true proportion of psychology papers that are not false positive is 'something like **25%**...[which] seems to be in the **same ballpark** as what we see in **many** biomedical disciplines.'"[14]
- Cooke concurred: "In fact, the problem extends far beyond psychology—**dubious** results are alarmingly **common** in **many fields of science**. **Worryingly**, they seem to be especially shaky in areas that have a direct bearing on human well-being—the science underpinning everyday political, economic and healthcare decisions."[15] "Evidence is mounting that medical research is particularly **prone** to irreproducibility. In 2012, Glenn Begley, a biotech consultant, showed that just **11 percent** of the preclinical cancer studies coming out of the academic pipeline that he sampled were replicable.... 'The truth is everyone knew that this was a problem,' says Begley. 'No one really knew the **magnitude** of the problem.'"[16]
- Ioannidis "claimed that sloppy methods could mean more than **half of all published scientific results** are flawed." Especially in those fields where effective "checks and balances are absent, irreproducible results are **rife**."[17]
- *Nature* conducted a survey of 1,576 researchers and found that "[m]ore than **70% of researchers** have tried and failed to reproduce another scientist's experiments, and **more than half** have failed to reproduce **their own experiments**."[18]

> *"...sloppy methods could mean more than half of all published scientific results are flawed."*

These realizations may be startling, but when the extended consequences of these examples of bad science are considered, the implications become even more concerning. Jeffrey Brainard, writing in *Science*, reported that over two dozen papers were retracted upon finding that one of the co-authors "was among the most prolific fraudsters known to science." Brainard continues,

> But the retractions, which began in 2015, didn't mean the papers were **gone for good**, or that their **influence waned**.... [M]any journal articles that cited one or more of [the] retracted papers did not warn readers that they referenced tainted work. Worse...the flawed findings were cited in 88 articles, published from 2003 to 2020, that are **systematic reviews** and clinical **guidelines**—potentially **influential publications that often help guide medical treatments**.... Would the authors and editors of these papers take action if alerted to the retractions...? For the most part [the investigators found—JM] the answer was no.... **[So, e]ven after they are retracted—publishing's death sentence—these papers live on thanks to citations**. And that could have real-world consequences, the study suggests. It found 39 of the 88 citing papers had drawn conclusions that, if

> [the] retracted papers were left out of the analysis, were likely to be substantially weaker. Journals flagged just four of these weakened studies for citing retracted papers. **The study's findings are "unfortunately very consistent" with others going back to the 1990s**, says Ivan Oransky, co-editor of Retraction Watch, which reports on retracted papers and tracks them in a public database.[19]

WHY IS THERE A CRISIS?

CLEARLY, to their credit, at least some within the scientific community do not deny that there is a problem. That realization has led to much discussion about the **causes** of the crisis. Subsequently, many have been identified. One such cause is the overreliance on statistics and probability (e.g., the *P* value[20]) in the determination of what constitutes reliable results.[21]

> The ASA [American Statistical Association] saw misunderstanding and misuse of statistical significance as a factor in the rise in concern about the **credibility** of many **scientific claims** (sometimes called the "reproducibility crisis")…. What scientists want is a measure of the credibility of their conclusions, based on observed data. The *P* value neither measures that nor is it part of a formula that provides it…. [There is an] **illusion** that the *P* value alone measures the credibility of a conclusion, which opens the door to the **mistaken notion** that the dividing line between **scientifically justified and unjustified claims** is set by whether the *P* value has crossed the "bright line" of significance…. Bright-line thinking, coupled with attendant publication and promotion incentives, is a driver behind **selective reporting**: cherry-picking which analysis or experiments to report on the basis of their *P* values. This in turn **corrupts science** and fills the literature with **claims likely to be overstated or false**.[22]

Cooke reported that, "Research published last year [2015—JM] by Megan Head of the Australian National University in Canberra and her colleagues showed that **dodgy** statistics are **rife** in the biological sciences. They scrutinized results from a wide range of scientific disciplines for evidence for 'p-hacking'—collecting or selecting data or statistical analyses until non-significant results becomes significant. They found it to be **particularly common in biological sciences**."[23] *Scientific American* concurred with the ASA, acknowledging that, "The use of *p* values for nearly a century to determine statistical significance of experimental results has contributed to an **illusion of certainty** and **reproducibility crises** in **many scientific fields**…. [I]t may be time for both scientists and the public to embrace the discomfort of being unsure" about the validity of scientific results.[24] It would be unwise to hold our breath waiting for that to occur, because scientists enjoy being respected, treated as the ultimate authorities, and receiving the funding that comes with supposed success.

Consider, for example, what Cooke highlighted about scientists and irreproducible research in *New Scientist*.

> Science is often thought of as a **dispassionate search for the truth**. But, of course, we are all only human. And most people want to **climb the professional ladder**. The main way to do that if you're a scientist is to **get grants and publish lots of papers**. The problem is that journals have a clear preference for research showing strong, positive relationships—between a particular medical treatment and improved health, for example. This means **researchers often try to find those sorts of results**. A few go as far as **making things up**. But a huge number **tinker** with their research in ways they think are harmless, but which can **bias** the outcome. This tinkering can take many forms…. You peek at the results and stop an experiment when it shows what you were expecting. You **throw out data points** that don't fit your hypothesis—something could be wrong with those results, you reason. Or you run several types of statistical analysis and end up using the one that shows the **strongest effect**. "It can be very hard to even see that **biases** might be entering your reasoning," says psychologist Brian Nosek at the University of Virginia in Charlottesville, who led the team trying to replicate 100 psychology studies. Take the tendency to scrutinize results that don't fit with your predictions more carefully than those that do. "There's no nefarious motive," says Roger Peng at Johns Hopkins University in Baltimore, Maryland. It's just **natural** to **assume** these results are likely to be "wrong." You might think that journals, which get peers from the same scientific field to review papers, would pick up on such practices. But, say critics, **the system isn't up to the task** [since reviewers do not generally dig into the nitty-gritty details of the research—JM]…. All this helps explain why so many studies **don't hold up** when others try to replicate them.[25]

Kevin Heng, writing in *American Scientist*, expressed concern about the resistance by many scientists to transparency, releasing all the information that would be needed to reproduce their results. "It is not unheard of to encounter published papers in astrophysics where insufficient information is provided for the reproduction of simulated results…. Scientific truth is **monopolized by a few and dictated to the rest**. Is it still science if the results are not

readily reproducible?"[26] More concerningly, are researchers attempting to hide the weaknesses of their studies by not making available all of the relevant information from their studies?

Cooke agreed with Nosek's acknowledgement of scientists' biases, highlighting that "[a]n **alarming** amount of research is flawed because of unconscious **biases**."[27] These include,

> Wishful thinking—Unconsciously biasing methods to **confirm** your hypothesis. Sneaky stats—Using the statistical analysis that **best supports** your hypothesis. Burying evidence—Not sharing research data so that results can be **scrutinized**. Rewriting history—**Inventing** a new hypothesis to explain unexpected results. Tidying up—**Ignoring** inconvenient data points and analysis in the write-up.[28]

Bohannon agreed with the tendency for many scientists to be biased in their work. Responding to the study uncovering major irreproducibility issues in psychology papers in 2015, he explained,

> The results lend support to the idea that scientists and journal editors are **biased**—consciously or not—in what they publish.... The bias could be due to scientists **throwing out** negative results, for example, or journal editors **preferentially** accepting papers with bigger effects. Some of the replications even found the **opposite effect** compared with the original paper. "This very well done study shows that psychology has **nothing to be proud of** when it comes to replication," says Charles Gallistel, president of the Association for Psychological Science. "Their data are **sobering** and present a **clear challenge** to the field," says Lynne Cooper, a psychologist at the University of Missouri, Columbia.[29]

Famous paleoanthropologist of George Washington University Bernard Wood and Alexis Uluutku acknowledged that in evolutionary science, "Paleoanthropology is subject to **confirmation bias**, whereby researchers may give undue weight to evidence that confirms their preexisting ideas."[30] "[E]xaggerated confidence" in results can lead to their inability "to be reproduced by others."[31] They warned that, while "[i]t is **accepted practice** in paleoanthropology to present detailed reconstructions of human evolutionary history that **rarely acknowledge** the extent to which they are **incomplete** and bound to change," it "would be more helpful, as well as **more accurate**, to acknowledge that the hominin fossil record is **incomplete** and that there are therefore **limits** to what can be said about it.... Overselling narratives based on incomplete data runs the risk of feeding mistrust between scientists and the public."[32]

Another study highlighted an additional source of bias: reputational bias. The peer-review process of the National Institutes of Health, for example, was found to tend to award grants based more on the "reputation of a scientist or their workplace," rather than "the **strength of their ideas**."[33] In *Nature's* survey of 1,576 researchers, the bulk of the scientists acknowledged that irreproducibility can often be a result of researchers' selective reporting, a pressure to publish, low statistical power/poor analysis, not replicating a result enough in the original lab, and insufficient oversight/mentoring,[34] and yet **the scientists publish their research anyway**. William Kaelin, professor of medicine at the Dana-Farber Cancer Institute, writing in *Nature*, expressed his concern about the change in biomedical research over the last several years: "[T]he goal of a paper seems to have shifted from **validating** specific conclusions to making the broadest possible **assertions**. The danger is that papers are increasingly like **grand mansions of straw**, rather than **sturdy houses of brick**."[35] Such an approach is bound to lead to mistakes.

When a scientist needs a certain result, the temptation is strong for him to ensure that result occurs,

(cont. on p. 56)

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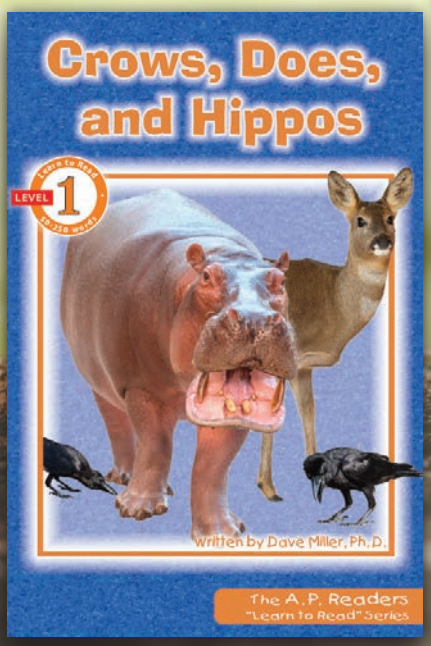

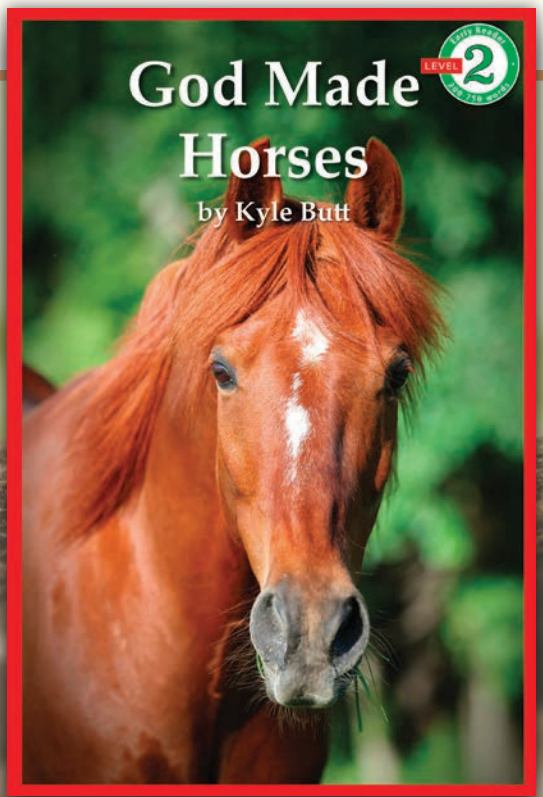

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rather than unbiasedly, dispassionately seeking the truth regardless of what it takes to find it and the result he finds. A 2011 psychology study was conducted with its objective to "show how easy it is to generate statistical evidence for pretty much anything, simply by picking and choosing methods and data in ways that researchers do every day"—a study which is clearly being proven true.[36]

McNutt, explaining why mistakes can occur in studies that cause it to be irreproducible, noted that,

> The system under investigation may be more complex than previously thought, so that the experimenter is not actually controlling all independent variables. Authors may not have divulged all of the details of a complicated experiment, making it irreproducible by another lab. It is also expected that through random chance, a certain number of studies will produce **false positives**.... Although there is always the possibility that an occasional study is **fraudulent**, the number of preclinical studies that cannot be reproduced is inconsistent with the idea that all irreproducibility results from misconduct in research.[37]

Although some scientists do not want to acknowledge that outright, intentional fraud is a significant contributor to the reproducibility crisis, one would be naïve to ignore its effect. Kornfeld and Titus argue that "irreproducibility is the product of two factors: faulty research practices and fraud," or in the words of Charles Babbage in 1830, "hoaxing, forging, trimming and cooking."[38] "[A] review of 2,047 life-science papers retracted from 1973 to 2012 found that around **43%** were attributed to **fraud** or **suspected fraud**." Surveys indicate that "2% of scientists and trainees **admit** that they have fabricated, falsified or modified data. And a 1996 study of more than 1,000 post-docs found that more than **one-quarter** would select or omit data to improve their chances of receiving grant funding."[39] A recent study published in *Scientific American* found that "collaborative dishonesty" is a common occurrence among researchers. When a group of researchers have the incentive of making more money if they lie in their reports, the study found that, "Across all studies and tasks... groups **tended to lie**.... We also showed that collaborative dishonesty is **contagious** and **escalates**.... The brazen liar's behavior influenced their partner. People were **more likely to lie** when their partner did. This dishonesty also **grew** over time."[40] To illustrate how deep the problem of fraud is, consider the alarming report made by *Nature* in 2014, titled "Gibberish Papers":

> The publisher Springer will remove 16 **computer-generated nonsense papers** that it had published in its subscription database, it said last week. The papers [were] created by a computer program called SCIgen.... [T]he US Institute of Electrical and Electronic Engineers...has already withdrawn more than 100 **nonsense** articles. The papers had been included in conference proceedings, some of which were supposed to be peer-reviewed.[41]

Not only did scientists use a computer program to write a paper on a made-up study, but they were able to get the paper **published**, **after** it had been peer-reviewed! Even high-profile individuals in the scientific community—the ones who are supposed to be setting the tone for and leading other scientists in proper scientific research protocols—are not immune to being charged with fraudulent scientific research. "Allegations of scientific image manipulation are threatening **Stanford University President** Marc Tessier-Lavigne, a neurobiologist and former biotech leader. Tessier-Lavigne came under fire last week [2022—JM] after an investigation by the school's student newspaper revived long-standing concerns about several publications on which he was a co-author."[42]

IS THE PROBLEM LIKELY TO BE FIXED?

OBVIOUSLY, in those many cases where a scientist publishes research intentionally that is fraudulent, the reproducibility problem will not improve unless a couple things happen. First, society should begin to more broadly and forcefully teach morality and ethics, as it once did. This, however, cannot ultimately fix the problem, unless society also acknowledges the Giver of moral law, Who provides humanity with the ultimate motiva-


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tion for adhering to His law. Without the incentive of eternal life in a real, glorious heaven and the fear of eternal damnation and Hell-fire in one's mind, his commitment to adhering to an ethical standard is severely weakened. In the words of Charles Darwin in his autobiography, "A man who has no assured and ever present belief in the existence of a personal God or of a future existence with retribution and reward, can have for his rule of life, as far as I can see, only to follow those impulses and instincts which are the strongest or which seem to him the best ones."[43] A God-less scientist who is highly motivated by fame, fortune, friends, or power instead of the truth that will set him free is perfectly poised to conduct dishonest science when it suits him. **Sadly, the bulk of the scientific community today is openly and brazenly God-less, even going so far as to define science in such a way that only natural explanations will be considered for anything that has ever happened in the Universe**. If **God** has been defined out of science, should it surprise us that the scientific community is becoming ever more **ungodly** in its practices?

A second "self-help" that the scientific community could implement to re-ignite a commitment to legitimate science and begin restoring faith in the scientific community would be to better expose and publicly punish the perpetrators of fraud in such a way that others will think twice before following in their footsteps. But even in those cases where researchers made unintentional, unconscious mistakes in a study that was published, the bad science problem is not likely to improve any time soon, because the only remaining impetuses that should drive researchers to be humble and cautious in their reported findings is gradually being erased.

In the *Nature* survey discussed above, the surveyors found from the polled scientists that, for one, "incentives to publish positive replications are low." Many researchers, therefore, see no reason to attempt to prove the legitimacy of a previous study by replicating it. The result is that many studies are being assumed to be accurate without replicated support for that conclusion. A researcher, therefore, is less concerned about reporting incorrect results in the first place, since it is unlikely that his research will be disproved by negative replications later.

Second, the surveyed scientists agreed that, when replications of a study are attempted by a separate lab, "journals can be reluctant to publish **negative** findings [i.e., findings that contradict the claims of the original study—JM]. In fact, several respondents who had published a failed replication said that editors and reviewers **demanded** that they **play down** comparisons with the original study."[44] Fanelli reported that today there is an

> unprecedented opportunity to purge the scientific record of false claims. But retracting those published claims remains a **rare** and **painful** process. There are **powerful incentives not to do so**, for all involved, from universities and scientists to publishers. Retractions still unwittingly punish all who take part.... The recalcitrance of scientists asked to retract work is not surprising. Even when they are honest and proactive, they have much to lose: a paper, their time and perhaps their reputation.[45]

Retractions, therefore, are rarer than they should be—which inevitably means that science being reported is not always as reliable as we are led to believe. Though retractions cannot completely fix the reproducibility crisis, (1) the shame of a retraction often acts as a deterrent to bad science, and (2) honest retractions would at least help the scientific community to save a little face in some cases (and help rebuild societal trust in science), since a retraction looks like an honest (though possibly inept) mistake, rather than an intentional cover-up or fraud. Although neither interpretation should inspire much confidence in a scientist, the latter is certainly more grave and would immediately call into question all of the scientist's previous research.

Retractions might also, in some cases, stop the world from banking its decisions on faulty evidence. So, many scientists are, to their credit, frantic to encourage the retraction process. Amazingly, however, some have proposed counter-intuitive solutions that are certain to exacerbate the problem. Martin Enserink, writing in *Science*, explained that, "Retractions are strongly associated with research misconduct. 'I became worried about public **shaming**,'"[46] said Richard Mann, mathematician at the University of Leeds in the United Kingdom. So, what's the solution? To solve the problem, some in the scientific community are advocating that journals stop using the "r" word, since it might be too scary for some scientists. Enserink explains that some have proposed a way "to make it easier to retract a paper—**by not calling it a retraction**."[47] Let's consider the logic of their solution:

1. Retractions **shame** the researcher and, therefore, provide a strong deterrent to bad or dishonest science.
2. Many scientists are conducting bad science and publishing it dishonestly, but will not openly admit their bad science because of the shame of a retraction.

▷ Solution: **eliminate shame** so researchers will retract more bad science.

We will grant that such a solution might seem almost logical

on the surface. It is likely, anyway, to encourage some to admit their mistakes and retract their findings. However, should not the goal be to **encourage good science**, not merely to **increase retractions**? We fail to see how eliminating the shame that accompanies a retraction would not open the flood gates for bad science, rather than encouraging good science. Though common today, it is an erroneous mindset that seeks to eliminate the **consequences** of bad actions rather than actually solving the problem by addressing the bad actions **themselves**. If a person is deserving of "public shaming," should he not be courageous and responsible enough to own the consequences of his mistakes, and allow his correction to improve his future scientific pursuits?[48] That is the kind of "tough love" the scientific community needs in order to improve itself and regain trust.

Sadly, since the bulk of the scientific community is naturalistic in its mindset, it has eliminated the primary driving Force for individual moral improvement. Unsurprisingly to the Christian, the scientific community is now beginning to feel the consequences of its stubborn rebellion against God. The God-less scientific community around us is feeling the continuing tremors preceding the inevitable implosion of its plummeting reputation and trustworthiness.

Kaelin, frustrated with the way science is being conducted by many researchers today, attempted to provide counsel to scientists, though his comments are a concerning portrait about modern science.

> Papers need to include fewer **claims** and **more proof** to make the scientific literature more **reliable**.... I worry about **sloppiness** in biomedical research: too many published results are true **only under narrow conditions**, or **cannot be reproduced at all**. The causes are diverse, but what I see as the biggest culprit is hardly discussed.... I fear the literature has **devolved** from papers making a single major claim that is **proved** in **multiple** ways to papers having **multiple** claims, each with a **single reed of support**. The final figures of papers today often seem a bridge too far. Overly broad claims push the peer-review system **past its limit**.... The main question when reviewing a paper should be whether its conclusions are likely to be **correct**, not whether it would be important **if it were true**. Real advances are built with bricks, not straw.[49]

"The main question when reviewing a paper should be whether its conclusions are likely to be correct, not whether it would be important if it were true."

Sadly, the likelihood of a widespread "repentance" movement among scientists is unlikely. On the positive side, however, some scientists recognize the authority of Scripture and seek, first-and-foremost, to please and glorify God as they conduct science. Though fallible men and women, since their foundation and perspective is correct, the science they conduct is far more likely to produce reliable results, since they are starting their study from the right place and have on the right lenses, which will allow them to view the world around them correctly as they study it.

IN SCIENCE SHOULD WE TRUST?

RECALL that in the 2016 *Nature* study referenced earlier, 1,576 scientific researchers were surveyed. The high number of surveyed researchers provides a reasonable glimpse at the mentality of the scientific community today.

Although 52% of those surveyed agree that there is a significant "crisis" of reproducibility, **less**

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May 2,4,9,11,16,18	Denver, CO	(303) 986-5800
May 12-14	Cleburne, TX	(817) 517-7713
May 20-21	Broken Arrow, OK	(918) 455-2800
May 28-June 3	Branson, MO	(417) 334-3866

> **than 31%** think that failure to reproduce published results means that the result is probably wrong, and most say that they **still trust** the published literature. Data on how much of the scientific literature is reproducible are...generally **bleak**. The best-known analysis, from psychology and cancer biology, found rates of around **40%** and **10%**, respectively. Our survey respondents were more optimistic: 73% said that they think that **at least half** of the papers in their field can be trusted.... When work does not reproduce, researchers often **assume** there is a perfectly valid (and probably boring) reason.[50]

The actual statistics indicate that reproducibility does not occur in well over 50% of studies, and yet the scientific community continues overwhelmingly to **blindly believe** in the validity of the studies, assuming without evidence that there are good reasons for the failure of reproducibility studies.

Should society have a "blind faith" in science and its naturalistic "prophets," as though they are unbiased, dispassionate, almost flawless truth seekers who are nearer to infallibility than the rest of the world? The evidence presented in this article ought to remind us always to maintain a healthy skepticism about the claims being made by the modern scientific community—especially in those studies where a conclusion is drawn that runs counter to the teachings of the infallible Word of God. Where should our trust be placed?

ENDNOTES

[1] As quoted in Jonathon Keats (2021), "Life Hack," *Discover*, 42[7]:36, November-December, emp. added.
[2] Marcia McNutt (2014), "Reproducibility," *Science*, 343[6168]:229, January, emp. added.
[3] Ibid., emp. added.
[4] Monya Baker (2016), "Is There a Reproducibility Crisis?" *Nature*, 533[7604]:452-454, May; David Peterson (2021), "The Replication Crisis Needs Field-specific Solutions," *Nature*, 594[7862]:151; Steven N. Goodman (2016), "Aligning Statistical and Scientific Reasoning," *Science*, 352[6290]:1180, June; Bruce Bower (2016), "Psychology's Replication Crisis Debated," *Science News*, 189[7]:8, April 2.
[5] Sonia van Gilder Cooke (2016), "The Unscientific Method," *New Scientist*, 230[3069]:41, April 16-22, emp. added.
[6] Todd Pittinsky (2015), "America's Crisis of Faith in Science," *Science*, 348[6234]:511-512, May.
[7] Peterson, 2021.
[8] John Bohannon (2015), "Reproducibility in Psychology," *Science*, 350[6267]:1459, December, emp. added.
[9] Jocelyn Kaiser (2021), "Key Cancer Results Failed to Be Reproduced," *Science*, 374[6573]:1311, emp. added.
[10] Bower, 2016, emp. added.
[11] Daniele Fanelli (2016), "Set Up a 'Self-Retraction' System for Honest Errors," *Nature*, 531[7595]:415, March 24.
[12] Donald S. Kornfeld and Sandra L. Titus (2016), "Stop Ignoring Misconduct," *Nature*, 537[7618]:29, September.
[13] McNutt, 2014, p. 229.
[14] John Bohannon (2015), "Many Psychology Papers Fail Replication Test," *Science*, 349[6251]:910, August, emp. added.
[15] Cooke, 2016, p. 39, emp. added.
[16] Ibid., p. 40, emp. added.
[17] As quoted in Cooke, p. 40, emp. added.
[18] Baker, p. 452, emp. added.
[19] Jeffrey Brainard (2022), "Silence Greets Request to Flag Retracted Studies," *Science*, 377[6601]:11, July 1.
[20] The *P*-value results from mathematical calculations that mathematicians/scientists often use to determine the "significance" of their results (the likelihood/probability of something being or not being the case).
[21] For a discussion of how reliance on probability has led to false conclusions with regard to evolution, see Jeff Miller (2011), "God and the Laws of Science: The Laws of Probability," Apologetics Press, https://apologeticspress.org/god-and-the-laws-of-science-the-laws-of-probability-3726/.
[22] Steven N. Goodman (2016), "Aligning Statistical and Scientific Reasoning," *Science*, 352[6290]:1180, June, emp. added.
[23] Cooke, 2016, p. 40, emp. added.
[24] Lydia Denworth (2019), "A Significant Problem," *Scientific American*, 321[4]:63, October, emp. added.
[25] Cooke, 2016, pp. 40-41, emp. added.
[26] Kevin Heng (2014), "The Nature of Scientific Proof in the Age of Simulations," *American Scientist*, 102[3]:177, May/June, emp. added.
[27] Cooke, p. 39, emp. added.
[28] Ibid., p. 40, emp. added.
[29] Bohannon, "Many Psychology Papers...," pp. 910-911, emp. added. Note that various psychologists have published studies attempting to argue for a "gay gene," against biblical child correction, etc. The reproducibility crisis in psychology adds support to the argument that such studies are no doubt biased, suspect, and undependable at best.
[30] Bernard Wood and Alexis Uluutku (2023), "The Inevitably Incomplete Story of Human Evolution," *American Scientist*, 111[2]:112, emp. added.
[31] Ibid., p. 113.
[32] Ibid.
[33] Jocelyn Kaiser (2023), "To Reduce 'Reputational Bias,' NIH May Revamp Grant Scoring," *Science*, 379[6629]:223, emp. added.
[34] Baker, p. 453.
[35] William G. Kaelin (2017), "Publish Houses of Brick, Not Mansions of Straw," *Nature*, 545[7655]:387, May, emp. added.
[36] Cooke, p. 30.
[37] McNutt, 2014, p. 229, emp. added.
[38] As quoted in Kornfeld and Titus, 2016, p. 29.
[39] Ibid., p. 29, emp. added.
[40] Margarita Leib (2023), "Collaboration's Dark Side," *Scientific American*, 328[2]:69, February, emp. added.
[41] "Gibberish Papers" (2014), *Nature*, 507[7490]:13, March 6, emp. added.
[42] Jocelyn Kaiser (2022), "Image Problems Besiege Stanford President," *Science*, 378[6624]:1033, December 9, emp. added.
[43] Charles Darwin (1958), *The Autobiography of Charles Darwin*, ed. Nora Barlow (New York: W.W. Norton), p. 94.
[44] Baker, p. 454, emp. added.
[45] Fanelli, p. 415, emp. added.
[46] Martin Enserink (2017), "Rethinking the Dreaded R-Word," *Science*, 356[6342]:998, June, emp. added.
[47] Ibid.
[48] According to Scripture, shame is an appropriate and effective corrective measure for improper behavior (e.g., 2 Thessalonians 3:14; 1 Peter 3:16; Titus 2:8).
[49] Kaelin, p. 387, emp. added.
[50] Baker, pp. 452-454, emp. added.

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Dave Miller

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